REPORT

ON THE

GEOLOGICAL SURVEY

OF THE

STATE OF VERMONT,

BY

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MONTPELIER:

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REPORT ON THE GEOLOGICAL SURVEY.

To His Excellency, Ryland Fletcher,

Governor of Vermont:

Sir:

My appointment by yourself to the office of State Geologist of Vermont, imposes the duty of an annual Report upon the progress of the work.

In this early stage of the Survey, and considering the numerous facts on the Economical Geology of the State presented by my predecessors, especially by Professor Adams, I have not supposed that it would be expected of me, that I should go into any detail as to the economical, or scientific part of the subject at this time. We have, indeed, collected numerous facts in the course of the summer; but they are in too crude and indigested a state as yet to be made public. All I shall attempt, therefore, will be to give the Government an idea of the plan we have adopted in the survey, and of the progress made in the work; referring, also, as the act providing for the completion of the survey makes it my duty, to the pecuniary part of the enterprise.

The history of the Geological Survey of Vermont is a melancholy one. Since it has commenced, twelve years ago, no less than three distinguished naturalists, who have had charge of it, have been called into eternity. And when I find myself in advanced life and full of infirmities, occupying their place, is it su-

perstition, or is it a reasonable apprehension, that makes me sometimes feel that a fourth individual may have the same summons before the survey is completed.

A great deal of labor has been devoted to this survey by my predecessors and their assistants. But from circumstances that imply no blame on their part, or want of watchfulness on the part of the State, little fruit remains. Prof. ADAMS had nearly completed the out-door work, and was almost ready to make a final Report, but the attempt to decipher his field-notes is so unsatisfactory, that it is easier and safer to go over the ground again: although he has left important help in the scientific part of the survey, by his marks upon certain maps. The same may be said of the other State Geologists, so far as the rocks and their note-books are concerned; though in Zoology and Botany, Professor THOMPSON has left important contributions.

It did seem, however, that the very extensive collection of rocks and minerals made mainly, I believe, by Prof. ADAMS, must teach much of the geological structure and economical value of the State. But alas, to give a climax to the list of untoward circumstances, the best and fullest of these collections, that belonging to the State, has mainly shared the fate of its beautiful State-House. Really, after so many disheartening circumstances, it speaks loudly in praise of the energy and perseverance of the Representatives of the State of Vermont, that they have not altogether abandoned this survey, with a feeling that any further effort would be fighting against Providence.

But these reverses have led me to enquire, whether the work cannot be conducted in such a manner that the facts ascertained and the specimens collected, shall be made secure to the State, even though death continue his inroads upon the laborers. This thought has had a leading influence in forming the plan for completing the survey, which, after consulting with your Excellency, I have adopted and acted upon the past summer.

I understand the survey to be limited to Geology and Mineralogy, excluding Zoology, Botany and Agricultural Chemistry, which were formerly included.

I suppose the following to be the leading objects to be kept in view in the prosecution of the survey:

1. To gain such a knowledge of the character, structure, and position of the rocks, as to enable us to delineate them upon maps and sections, which can be used both scientifically and economically.

2. I cannot believe that the surface Geology of the State, which in Vermont is particularly interesting, should be neglected; for although its chief utility consists in its scientific bearings, yet it reveals such wonderful changes in the early history of the surface, that every intelligent man will be anxious to know them.

3. To form a collection of all the rocks and minerals of the State, for exhibition in the Geological Room of the new State-House.

4. To obtain, for the same Room, smoothed and polished specimens of all the rocks and minerals in the State of economical value, so as to bring before the visitor an exhibition of its mineral wealth.

5. To obtain chemical analyses of all useful rocks, minerals, marls, &c. not already analysed. For although a large number of such analyses were secured and published by Prof. ADAMS, yet many others will doubtless be desirable.

In the organization of a Geological Corps for a survey, as well as in the plan of it, these objects were kept in mind. It was distinctly understood, that in consideration of my age and infirmities, I must depend chiefly upon younger men to collect specimens and trace out the rocks; while I should be expected to visit the most important localities and the spots most difficult to unravel. Accordingly, with the consent of your Excellency, I appointed ALBERT D. HAGAR, Esq. of Proctorsville, and my eld-

est son, Dr. EDWARD HITCHCOCK, as Geological Assistants; and my youngest son, CHARLES HENRY HITCHCOCK, as Chemist to the survey: it being understood that Mr. HAGAR should be employed the whole of the time, while my sons were to alternate, so as to make their labor only equivalent to a second assistant. The responsibility of the whole work, of course, rests on me; and so confident am I of the ability and fidelity of my assistants that were I to be taken away, I should have no fears but that the survey would be carried through successfully by them. This is one of the ways in which I should hope to secure to the State the results of the survey, even though prematurely suspended, as it too often has been.

Another mode of accomplishing the same object lies in the plan which has been adopted in the prosecution of the work. From my own former explorations in the southern and central parts of Vermont, and from an outline Geological map left by Professor ADAMS, we were satisfied that nearly all the rocks of the State ran through it lengthwise, or parallel to Connecticut River. It seemed to me, therefore, that if we were to measure sections running nearly east and west across the State at intervals of every few miles, we should gain several advantages. First, we could in this way exhibit to the eye upon paper the Geological position of all the rock formations. Secondly, such delineations would enable us to construct and color a Geological map of the State. Thirdly, by collecting specimens of all the rocks along a section, and placing them in that order in the State Cabinet, the Geological character of the State would be displayed, and those who come after us could verify our observations and correct our mistakes. Interesting localities, lying between the sections, are also visited, and specimens collected, to be placed in their proper position in the Cabinet. A system of packing and labelling has likewise been adopted, by which each specimen would at once be referred to its true place, even without the presence of any of the existing Geological Corps. Fourthly, in

this way we should be sure to visit every accessible portion of the State to measure sections and collect specimens. Fifthly, if at at the close of the field-work each year, the sections measured be put upon paper, and the boundaries of the several rocks be marked upon a map, every fact of importance would be thus secured to the State in any event. Had my predecessors transferred their facts from their note-books to maps and sections, a large part of the work which we are doing would be unnecessary.

In pursuance of this plan, we have, during the past summer, nearly completed nine sections, crossing the State at intervals of about twenty miles, through its entire length. How many more it may be necessary to measure, cannot be determined till these nine are put upon paper. Indeed, until this is done, I cannot judge accurately what progress we have made in our work. One of my assistants, therefore, is at present employed in the work of protraction.

In order to give the Government a clear idea of the nature of this work, I propose to suspend one of these sections at Montpelier during the approaching session of the General Assembly, with the rocks collected on that route placed beneath. Mr. HAGAR will be there for a time to make explanations, and he will, also, be able to exhibit at least a few cut and polished specimens for illustrating the economical Geology. In this way I trust that the members of the Government can form a clear idea of what we are doing, and of the appearance of the new Geological Hall when it shall be completed and filled with specimens.

The work of measuring these sections and collecting at least 1400 specimens, has been mainly done by my assistants: my own time in the field having been scarcely three weeks. I had hoped to do much more. But in the measurement of the first section I laid out too much work for the week, and for several days was exposed to severe storms of rain and snow, whereby my health was so seriously affected, that I have felt scarcely

equal to the severe labors of a Geological exploration at any time since. I regret this the less, because the preliminary work which has now been done, will enable me to judge more accurately towards what points to turn my attention, should the Government direct, and Providence permit me to resume these labors another year.

Soon after receiving my commission I addressed a letter to the Committee for building the new State House, suggesting the desirableness of devoting a room in the new edifice, to a State collection of rocks and minerals. The Committee responded very liberally by appropriating a room, twenty-six by twenty-eight feet, for this purpose. In that room, if we finish the survey, we hope to place such collections as every citizen of Vermont will be proud of; and such as will afford a more convincing proof of the value of the survey, than a labored argument. I know enough of the rocks and minerals of the State, to be satisfied that probably no other portion of the Union, of equal size, can make so rich a display of mineral wealth. I ought, perhaps, to except some mining districts of the South and West: for although gold occurs here, on a belt extending probably through the whole State, appearances, I am happy to say, do not lead us to expect to find it in quantity sufficient to break up the regular pursuits of industry, and introduce the immoralities and recklessness usually seen in rich gold-producing regions. The leading subterranean products of Vermont, which are inexhaustible and will always be in demand at home and abroad, are marble, serpentine, soapstone, iron, slate, granite, and limestone for cement. Scattered as they are through the whole length of the State, and most of them of the finest quality, they must always be a source of wealth; not coming in fitful waves like the precious metals, but in a steady stream, to reward patient industry.

The limited amount of pecuniary means in our hands for carrying on the survey, will prevent our purchase for the Cabinet of cut and polished specimens of these various substances. But

we have appealed to the liberality of the owners of quarries and mines, to present cubic blocks from their works, four inches across, to the State collection. And thus far, I believe, we have not found an individual who has not promptly met our wishes. But should this paragraph meet the eye of any individuals who could aid us and confer a benefit on the State in this matter, to whom we have not spoken, I beg them to consider this invitation as addressed to them. Others may have specimens in their possession, desirable for their beauty or scientific value, which would be of great service in a public collection, but of little value to an individual. I would fain hope that a just pride to have the Cabinet worthy of the State, will bring in many such specimens, as it already has to some extent.

It will indeed demand a long time and strenuous efforts to make the Cabinet in this manner, such as it ought to be in such a State. If we had the abundant means devoted to the museums of Economical Geology connected with the Geological Surveys of Europe, or of the neighboring province of Canada, there would be little difficulty in making an equally splendid exhibition in your Geological Hall. But persevering industry on the part of the Surveyors, and an interest in the subject in the community, will go far to make up for a deficiency of money.

As another means of aiding the Survey, I take pleasure in referring to the generous hospitality, which we have experienced in every part of the State. In all my Geological experience I have never seen any thing equal to it. And it is gratifying, not merely for the reason just referred to, but because it shows that the true and hearty hospitality, for which the old Puritans were remarkable, has not died out from the whole of New England.

By the act of the General Assembly for completing the Geological Survey, it is made my duty to "report the expenses of the survey for the current year, together with an estimate of the probable amount of funds necessary for its completion." By

section fifth of the act, "the sum of one thousand dollars is appropriated until otherwise ordered by the Legislature, for the purpose of carrying into effect the provisions of this act." Our expenditures, therefore, must be limited by a thousand dollars this year. Up to this date the account stands as follows:

For an Aneroid Barometer,	$22 50
For horse and wagon during the summer,	45 00
My own expenses, (railroad $13 75,)	34 32
Expenses of my assistants through the summer,	240 88
Whole expenses,	$332 10

Deducting three hundred and thirty-two dollars and ten cents from one thousand dollars, we have remaining, six hundred and sixty-seven dollars and ninety cents, as compensation for the services of assistants. For I shall charge nothing for the few weeks I have devoted to the survey this year, except my necessary expenses: partly because the time has been so short, and partly because I would not further reduce the small salary which will be left to those who have devoted nearly all the summer, and must devote a large part of the rest of the year to the work, if it be carried on. Divided between two assistants, the share of each will be three hundred and thirty-three dollars and ninety-five cents. This sum must be still further reduced by whatever expenses may be incurred this autumn and the coming winter, in arranging specimens, and especially in making chemical analyses. I doubt not that my assistants will go forward with their work as far as possible, although it is obvious that with such a compensation, it must depend rather upon their generosity and love than upon any claims which the State have upon them on the ground of salary.

As to "the probable amount of funds necessary for the completion" of the survey, I would say a few words.

In my judgment the out-door work could, without difficulty, be completed in another season. But I fear this could not be

done, if no more than the thousand dollars appropriated annually by the act to the survey, be devoted to it. If this were increased to fifteen hundred dollars, I should scarcely fear to pledge myself, Providence permitting, to complete the explorations next summer; so that nothing would remain but the arrangement of the specimens and making out the Final Report. For we could then form two exploring parties, at least a part of the time, which our funds at present will not allow us to do. I do not suppose that all the scientific questions relating to the rocks of Vermont could be settled in that time; and it must be confessed that these are neither few nor unimportant. Most of the rocks of the State are what are called metamorphic—the most difficult to name and describe of all rocks, though usually the most important economically. But what is most important to the pecuniary interests of the State, could, I think, be ascertained, and very many facts stated concerning the scientific relations of the rocks, for the use of the theorist.

I have supposed it to be the wish of the State, as it certainly is that of the Geological explorers, to finish this survey as soon as it can be done well; and therefore I have made the above suggestions, presuming, also, that such a course would be cheaper in the end than longer delay, with a less annual appropriation. But if the Government judge otherwise, and wish us to proceed as we have during the present year, we will do all that we can to hasten the work to the end. Or if the Government, in view of the exposition now made, should conclude to suspend it altogether, we have nothing to do but submit, and endeavor to place in their hands the results thus far obtained. We cannot believe, however, that the people of Vermont wish to have the work brought so prematurely to a close, that the Final Report shall be a disgrace, when it ought to be an honor, to the State, and a guide to those practical men who are seeking to develope its Geological resources.

I will add, that as yet we have drawn upon the State Treasury for one hundred and eighty-three dollars only; also, that a delay to receive the notes of my assistants, will make it impossible to complete the section, which I propose to exhibit at Montpelier, under one or two weeks.

Respectfully submitted,

EDWARD HITCHCOCK.

AMHERST, Oct. 7th, 1857.